CS-703B

SOFT COMPUTING

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. 10×1 = 10

(i) Which theory defines the GA most?
(A) survivor of the fittest (B) elimination of the unwanted
(C) gradient decent (D) vagueness

(ii) A fuzzy set A is said to be normal, when
(A) all the elements have membership value 1
(B) all the elements have membership value 0
(C) there is at least one element with membership value 1
(D) 50% of the elements have 1

(iii) Back Propagation is _____ technique.
(A) supervised learning (B) unsupervised learning
(C) reinforcement learning (D) semi supervised learning

(iv) Which crossover technique can be used for Travelling Salesman Problem?
(A) single point crossover (B) multipoint crossover
(C) uniform crossover (D) ordered crossover

(v) If A = {(a, 0.3), (b, 0.7), (d, 1)} is fuzzy set belongs to domain of discourse X = {a, b, c, d}, then A' is given by
(A) A' = {(a, 0.7), (b, 0.3)} (B) A' = {(a, 0.7), (b, 0.3), (c,1)}
(C) A' = {(a, 0.7), (b, 0.3), (c,1), (d,1)} (D) A' = {(a, 0.3), (b, 0.7), (c, 0.5)}

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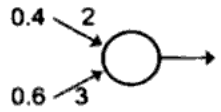
(vi) What will the output of the following neuron, where identity activation function is used?



(A) 2.2 (B) 2.4 (C) 5 (D) 1

(vii) To classify the output of logical XOR, what kind of ANN can we use?
(A) Madaline (B) Adaline
(C) single layer perceptron (D) all of these

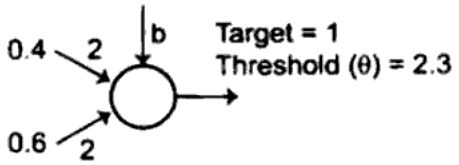
(viii) Which one is applied for Simple GA?
(A) crossover probability is high and mutation probability is high
(B) crossover probability is low and mutation probability is high
(C) crossover probability is high and mutation probability is low
(D) crossover probability is low and mutation probability is low

(ix) Kohenen SOFM is
(A) supervised (B) unsupervised (C) reinforcement (D) semi-supervised

(x) Which concept ensures selection of best chromosome for the next generation?
(A) ranked selection (B) elitism
(C) tournament selection (D) roulette wheel selection

(xi) α-cut of fuzzy set generates a
(A) fuzzy set (B) rough set (C) universal set (D) crisp set

(xii) What will be the minimum value of Bias (b), if Binary Step Function is used as activation function with threshold 2.3, and target is 1, for the following network?



(A) 0.3 (B) 0.5 (C) 0.2 (D) 1.0

GROUP B
(Short Answer Type Questions)

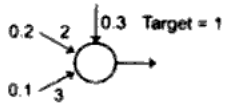
Answer any *three* questions. 3×5 = 15

2. What is meant by supervised, unsupervised and reinforcement learning? 5

3. (a) What are the differences between crisp set and fuzzy set? 2
   (b) Compare Sugeno FIS and Mamdani FIS? 3

4. (a) What happens in a GA, if (i) Crossover rate is increased, (ii) mutation rate is increased? 4
   (b) What do you understand by pareto optimal solution? 1

5. Consider the following ANN with Sigmoidal Activation function, and answer the following: 1+1+3
   (a) Total input to the neuron
   (b) Final output of the neuron if λ=1
   (c) Error, for λ=2, λ=1, if the target is 1



6. Let X = {1, 2, 3, 4} and Y = {a, b, c, d} are two domain of discourse and A, B, C are three fuzzy set, where 1+2+2

   A = {(1, 0.5), (2, 0.6), (3, 0.8)} $\subset$ X

   B = {(2, 0.4), (3, 1), (4, 0.7)} $\subset$ X

   C = {(a, 0.2), (c, 0.9), (d, 0.3)} $\subset$ Y

   Calculate: (a) $A \cup B'$ (b) $B' - A'$ (c) $R = C \times B$

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Perform max-min(RoS) for the following Fuzzy Relations R, S, where 7

   $R = M \times N$ and $S = N \times O$, where M,N,O are fuzzy set given by

   M = {(1, 0.2), (2, 0.3), (3, 0.5), (4, 0.45)}

   N = {(a, 0.1), (b, 0.42), (c, 0.5), (d, 0.4)}

   O = {(u, 0.5), (v, 0.3), (w, 0.4), (x, 0.7)}

   (b) Calculate the α-cut for the Fuzzy set N (above) where α = 0.42. 2

   (c) Explain the Centroid, Centre of Sums (COS) and Centre of the largest area defuzzification method with proper example. 6

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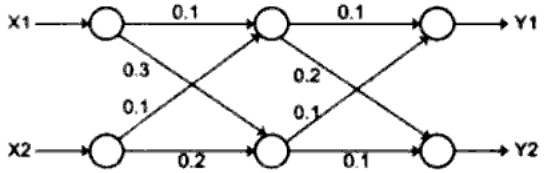
8. (a) How in simple does crossover and mutation help to solve the problem of Local Optima? 4
   (b) Justify the importance of selection in GA. 4
   (c) Consider a person X, who has to visit 6 cities namely A, B, C, D, E and F. He can start from any one of the cities and come back to the starting city, visiting every city exactly once except the origin. Design a GA based optimization technique to find the minimum costing route for X. Proposed and describe in context to X, any two crossover and any one mutation technique. 7

9. (a) Explain how Adaline learning rule is different from Single Layer perceptron. 3
   (b) Calculate the new weight of the following ANN using BP up to one epochs 8



   Let Input X1 = 1, X2 = 2 and desired Outputs are Y1 = 0.4 and Y2 = 0.5 respectively. Let momentum (α) = 0.2 and learning rate (η) = 0.5. Also consider that we have used identity function as Activation Function for input layer and Binary Sigmoidal function as Activation function for hidden and output all layers with λ = 1.

10.(a) Consider Kohonen SOFM with two cluster units and five input unit. The weight vectors for the cluster units are given by 7+5

$$W_1 = [1.0, 0.9, 0.7, 0.5, 0.3] \qquad W_2 = [0.3, 0.5, 0.7, 0.9, 1.0]$$

   Use the Euclidean distance to find the winner for the input pattern W_{in} = [0.5, 0.8, 0.7, 0.6, 0.7]. Using the learning rate coefficient 0.25, find the new weight for the winning input.

   (b) Design a Hebb net to implement logical OR function using bipolar input and output. 1
   (c) Define linearly separable problems. Why logical XOR cannot be designed by single layer perceptron? 2

11. Write short notes on any *three* of the following: 3×5
   (a) Ant Colony Optimization
   (b) Crossover Probability and Mutation Probability
   (c) Fuzzy Membership Functions
   (d) Associative Memory
   (e) McCulloch-Pitts Network